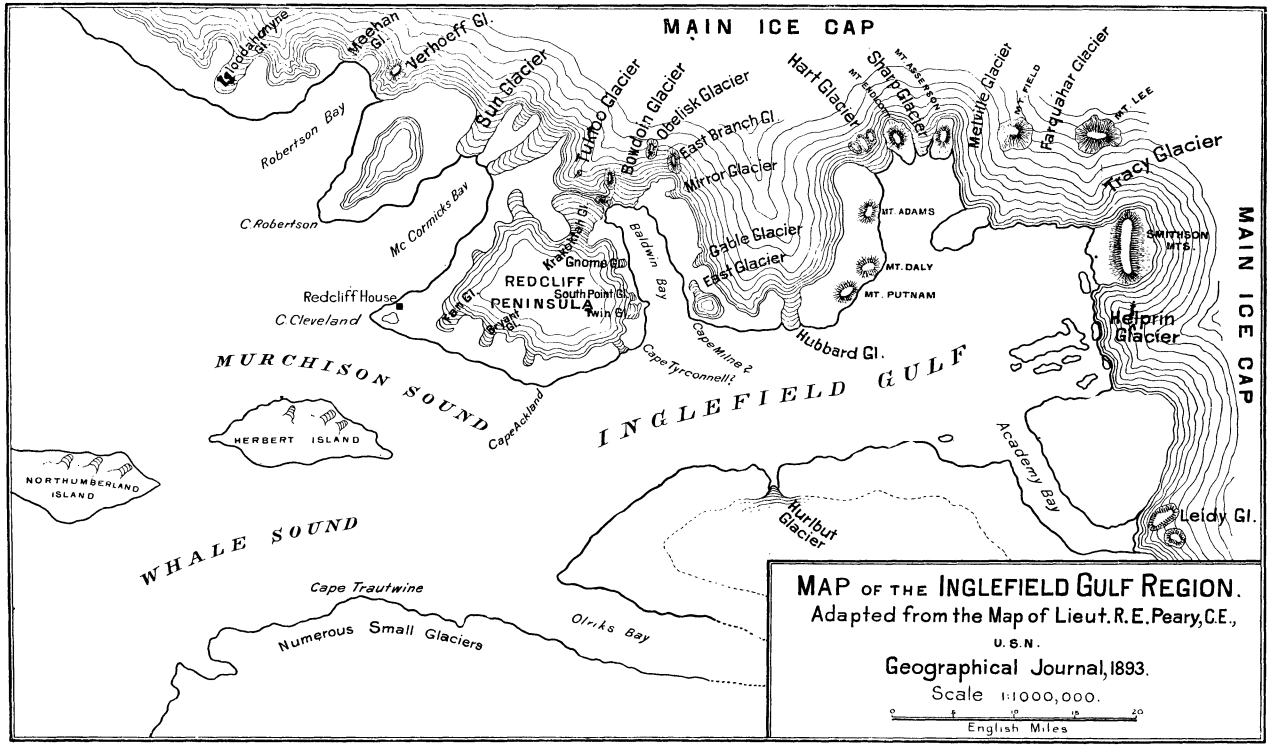
# GLACIAL STUDIES IN GREENLAND. IV.

## Glaciers of the Inglefield Gulf Region.

*General features of the district.*—As my chief studies on the glaciers of Greenland lay within the environs of Inglefield Gulf it will be helpful to take a brief survey of the region before entering upon a special description of its glacial phenomena. It is worthy of note at the outset that it is the westernmost portion of Greenland that is indented by Inglefield Gulf. Prudhoe Land, which constitutes the extreme western projection, lies immediately on the north, while next on the south lies the unnamed peninsula which ends in Cape Parry and constitutes the next most westerly portion. The position of the gulf is therefore one of meteorological exposure, if westerly projection constitutes such exposure.

It is equally worthy of note that the district lies on the border of one of the widest parts of Greenland, if not altogether the widest part. With the present incomplete knowledge of the east coast, an unqualified statement is inadmissible. According to some of our maps of the better order, the tract between 77° and 78° north latitude, which embraces Inglefield Gulf, is wider than any similar portion north or south. According to other maps the breadth near 70° north latitude fully equals, or slightly exceeds it. In the former region the tract stretches over more than 50° of longitude. The convergence of the meridians in this high latitude, however, makes this an illusive statement, unless the fact of their close approach be borne in mind, but it serves to emphasize the width of the area in whose glaciation we are interested. In round figures and more familiar measures, the breadth may be put down at about 700 miles.

If we turn from the width of the land to the more pertinent matter of the width of the ice sheet, we find all maps agreeing


MAIN ICE CAP
Maehan Gl.
Verhoeff Gl.
Sun Glacier
Tuttoo Glacier
Bowdoin Glacier
Obelisk Glacier
East Branch Gl.
Hart Glacier
Sharp Glacier
Mirror Glacier
Melville Glacier
Farquahar Glacier
Tracy Glacier
Robertson Bay
C. Robertson
Mc Cormicks Bay
Kyabuna Gl.
Gnome Gl.
REDCLIFF PENINSULA
South Point Gl.
Twin Gl.
Redcliff House
C. Cleveland
Baldwin Bay
Gable Glacier
East Glacier
MT. ADAMS
MT. DALY
MT. PUTNAM
SMITHSON MTS.
Helprin Glacier
Hubbard Gl.
Cape Tyrconnell
Cape Milne
MURCHISON SOUND
Cape Ackland
INGLEFIELD GULF
HERBERT ISLAND
NORTHUMBERLAND ISLAND
WHALE SOUND
Academy Bay
Hurlbut Glacier
Leidy Gl.
Cape Trautwine
Numerous Small Glaciers
Olriks Bay
MAIN ICE CAP
MAP OF THE INGLEFIELD GULF REGION.
Adapted from the Map of Lieut. R. E. Peary, C.E., U.S.N.
Geographical Journal, 1893.
Scale 1:1000,000.
English Miles

that here the ice finds its greatest expanse. The glacial phenomena we are to consider relate, therefore, to the widest part of the widest *mer de glace* of the northern hemisphere.

Inglefield Gulf indents this broad tract to a depth of about 100 miles, or one-seventh of its width. The trend of the gulf is a little north of east. It has a breadth of from eight to twelve miles. There are two notable branches on the north side, McCormick Bay and Bowdoin Bay, both of which have become memorable from their association with Lieutenant Peary's work, the former having been his headquarters during his first exploration, and the latter, during his second. On the south side there are likewise two arms, Olriks Bay and Academy Bay.

*General geology.*—Two great series of rocks are represented in the district, the one an ancient complex crystalline terrane, probably Archean, the other, a clastic series of unknown age. The crystalline series is chiefly composed of gneisses in which a strong hornblendic tendency is manifest, some parts, indeed, being largely hornblende. There are also embraced in it some belts of quartzite which bear a general resemblance to the quartzites of the Algonkian series of the upper Mississippi and Lake Superior regions.

The clastic series embraces three distinguishable members. The lowest is a red sandstone which attains a thickness of perhaps 1000 to 1500 feet. Its beds possess moderate massiveness, lie at low inclinations, and rest unconformably upon the crystalline series. The discordance is very great and indicates that the crystalline terrane had assumed essentially its present attitude, had undergone very great erosion, and had approached the existing topographic expression before the sandstone series was laid down upon it. If the sandstone were removed, the relief of the topography would apparently not be less than it is now, and not very different from it in general aspect.

Lying conformably upon the red sandstone is a somewhat thicker series of pinkish gray sandstone. This has a quartzose constitution much the same as that below, but somewhat exceeding it in hardness. While well indurated, it is unmetamorphosed.

Under glacial action it manifests its endurance very markedly, and constitutes, in favorable situations, a very notable constituent of the drift. Its thickness is roughly estimated at 1500 to 2000 feet.

Reposing conformably upon the pinkish gray sandstone lies a deep series of more thin-bedded sandstones and shales, of reddish brown and dark hues. The sandstones, which predominate over the shales, are less heavily bedded than the series below. They manifest a marked disposition to split up into thin slabs under exposure, and hence degradation proceeds with much facility. Interstratified with the sandstones there are shaly beds of kindred constitution which were obviously once only the more muddy sands of the accumulating sediments. Besides these sandy shales there is found on the south side of Redcliff Peninsula a very notable horizon of finely leaved shales of dark color, which disintegrate with great readiness into a soft talus of leaflets, extremely grateful to the feet of the explorer after their hard pounding over the rocky or bowldery surfaces that nearly everywhere prevail unsoftened by soil or vegetation. These more pronounced shales do not, however, appear to be sharply differentiated from the common sandstone and shale series, but possibly a more thorough study of the region would find grounds for separation. The thickness of the whole series can only be vaguely estimated from such cursory observations as I was able to make, but I should judge that it exceeds rather than falls below the estimate of the preceding series. No careful measurements of the thickness of any of these series were made, and the figures given are general estimates that will be serviceable only in giving an approximate idea of the massiveness of these formations.

The conformity of the three sandstone series among themselves suggests that there may be no vital distinction between them and that they represent a consecutive sedimentation reaching a total thickness of four or five thousand feet perhaps.

Unfortunately the series is extremely barren of fossils. The absence of these cannot be charged to any catastrophe which the

series has undergone, for, while it is faulted in some places and gently tilted generally, it is not crumpled nor folded and shows no signs of destructive metamorphic changes. While it is by no means safe to assume the entire absence of fossils; while, indeed, it is perhaps safer to assume their presence, they are very rare, or else circumscribed in their distribution within the region studied; for, though attention was chiefly absorbed by the glacial phenomena, it was incidentally necessary to traverse much territory occupied by the sedimentary rocks, and their exposure is so ample as to afford great facilities for observation. Vegetation is not by any means absent, but it is so scattered as to offer practically no concealment of the surface. The intense frost has split the surface beds into innumerable slabs which lie in the greatest profusion over the surface. At the same time there has been very little disintegration of rock into soil, or else it has been washed away, and hence almost no concealment from that source. While in some parts drift from the crystalline series interposes some concealment, the extent of this is limited. The importance of finding a sufficient number of fossils to identify the formations was fully realized and a fairly constant outlook for them was maintained, but without result. All others who have visited the region have been, so far as I can learn, equally unsuccessful. There remain, however, grounds for hope that sufficient fossils will ultimately be found to determine the age of the formations. They have usually been referred, with doubt, to the Tertiary, because of the presence of that series, with a similar constitution, in the Disco region. So far as I can see, they might, with equal plausibility, be referred to an earlier age.

The area occupied by the clastic series is only imperfectly known. The ice mantle of Prudhoe Land and the great inland sheet creep out upon it and conceal its inland limit in part. But such inferences as can be drawn from the constitution of the drift point to a limit at no great distance back from the shore. This is strongly supported by the fact that the arms of Inglefield Gulf reach the crystalline series and even the gulf coast is in part formed by it. The head of Bowdoin Bay, for instance, has crys-

talline walls on either side, though at its mouth there rise picturesque cliffs of sandstone. The Redcliff Peninsula, a triangular area, about fifteen miles on a side, lying between McCormick and Bowdoin Bays (see accompanying map), clearly has a nucleus of crystalline rock. On the south face, the clastic series forms the entire coast line. Each of the glacial tongues, however, that descends from the peninsular ice cap brings crystalline bowlders. As the ice cap is entirely indigenous to the peninsula, and the glacial movement is outwards in all directions, none of the crystalline bowlders can be derived from any outside source. Besides, the nucleus is actually exposed on the northwestern side of Bowdoin Bay. East of Bowdoin Bay the clastic series occupies a narrow tract along the Gulf, while farther back the country is made up of the crystalline series, so far as could be seen directly, or inferred from the drift. On the south side of the Gulf, a part of the coast is formed by crystalline rocks, and a part by the clastic series. At the head of the Gulf, the islands, so far as seen, and the promontories on the south side, are composed of the crystalline series, but the Smithson Mountains (which were, however, only observed at a distance by a field glass) appeared to be formed of pinkish gray sandstone. As they lie in the line of the strike of that formation, it seems not improbable that the old clastic basin extended farther into the mainland than the present basin.

The foregoing observations, taken together, appear to justify the inference that the ancient gulf in which the clastic series was laid down was somewhat more extensive, but not greatly more extensive, than the present one, and that it had approximately the same form, though departing from it in some particulars. It appears also a natural inference that the old basin was the parent of the new one in the sense of having determined its location and measurably its dimensions. It is doubtless an instance of an ancient feature perpetuating itself through later geological ages.

*General topography of the region.*—The stratigraphy of the district has already led us to a recognition of its greatest topographic feature, the basin itself. A study of its profiles quickly

reveals its second great feature—an upper plane, dominating the higher land and constituting it a very pronounced plateau. We may recall that in a previous sketch of the topography of the coast to the southward, it was observed that though somewhat varying, it takes on a prevailing mountainous character. Indeed, I think that all descriptions of the ice-free belt of West Greenland represent it as mountainous, and these descriptions are fully justified so far as the region south of Melville Bay is concerned. Fortunately a new phase is assumed in this more northerly region.

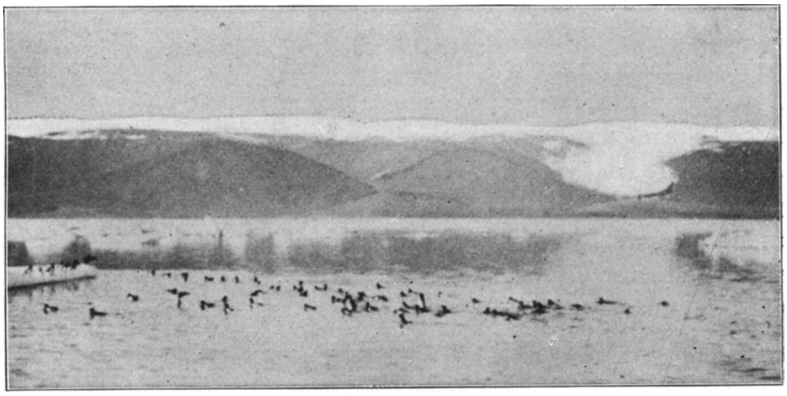


FIG. 17.—General view of the central portion of the south face of Redcliff Peninsula, introduced here especially to illustrate the non-mountainous plateau upon which the ice cap develops. The ice edge is about 2000 feet above and three miles back from the Gulf. Bryant glacier, at the right, is a typical ice tongue descending from the ice cap through one of the broader and deeper valleys. It will be described in detail farther on. The plateau face is here formed of the sandstone and shale series described above; but the Bryant glacier brings down débris from the pinkish gray sandstone and the crystalline series.

Here we have a pronounced plateau without bordering mountains. The few points about the head of the Gulf that are called mountains rise only a few hundred feet above the plateau, and would be altogether negligible in a really mountainous region. This upper plane lies about 2000 feet above the sea level. Along a portion of the coast there is a precipitous rise from the water to this plane. In other portions, and these have much greater extent,

there is a narrow skirting tract of lower ground, a portion of which is of moderate slope, and often takes the form of a series of imperfect terraces. These, in some places, appear to be merely developments of the talus slope, but in others to constitute remnants of a lower plane of erosion, which has a somewhat wide prevalence, although not an important feature of the general topography of the region. From these lower skirting tracts the ascent to the upper plain is usually steep, though rarely strictly precipitous.

The edge of the plateau is notched by a series of short valleys that lead down from the summit plane. The length of these is not usually more than two or three miles, except in the case of the greater arms, where, if we include the portion occupied by the bays, the length reaches a dozen or even a score miles. At the head of the valleys, the descent from the plateau is usually at first prompt, while towards the mouths of the valleys the gradient becomes lower and is usually determined by the lodgment of gravelly wash from above. The heads of the larger valleys are usually occupied by glaciers. These descend from the plateau into the valleys either by cataracts or by steep slopes. If the glacial tongues do not extend the full length of the valley, as is frequently the case, the lower portion is occupied by a broad plain of gravel and bowlders of glacial derivation, which gives a free and gentle descent to the glacier in its terminal portion. At the junctions of these glacial valleys with the Gulf, there is sometimes a notable delta, broad and symmetrical, but not very large. They do not protrude far into the Gulf even when its waters are not deep The most notable of those observed was the one in front of the Fan glacier. The beautiful fanning out of the glacier at its extremity is reproduced in an almost equally symmetrical deployment of its delta. There are several of the valleys, however, which, though filled nearly to their mouths with glaciers, have no protruding deltas at all. The little embayments at their mouths are not yet filled with glacial wash. This is an observation worthy of note in its bearings upon the duration and activity of the glaciation. The valleys occupied by the Gnome, the South Point, and the East glaciers, may be cited as illustrations.

Returning to the upper plane, it is worthy of note that its undulations are chiefly confined within a range of 500 feet. A panoramic view generally gives a mildly undulatory profile, as may be seen from the accompanying illustrations, and as will be more fully shown in the photographic illustrations that will be hereafter introduced in illustration of the glacial phenomena. Sometimes the profile is very markedly uniform. See Fig. 18. In the immediate district of my studies, there was but one prominence that has been dignified by the name of mountain, Mt. Bartlett, which overhangs Falcon Harbor and the headquarters of Lieutenant Peary, and which receives its characterization chiefly because of the sheer face it presents towards Bowdoin Bay, and because of its close association with the exploring expeditions. Its extreme height is little more than 2600 feet, and its rise above the plateau but a few hundred feet. About the head of the Gulf are several prominences reaching, if I have noted Lieutenant Peary's observations aright, perhaps 3000 feet. They are conspicuous solely because they are promontories. In no instance do these reach the grade of true mountains when referred to the plane of the plateau. Were it extended over the area of the Gulf, all would be reduced to hills of moderate dimensions.

*General bearings of the geological and topographic features upon the glacial phenomena.*—I have dwelt upon some of the foregoing features, especially the last, because of their bearings upon the behavior of the ice sheet. In drawing inferences from this field and applying them to our own glacial domain, it is obvious that the effects of topography must be eliminated or discounted. In so far as the border of Greenland is roughly mountainous, in so far a disturbing factor is introduced into the deployment of the border of the ice. To this extent it must be presumed to depart from the habit which it would adopt upon the plains of northeastern America. It is scarcely necessary to note that the great drift sheet of our mainland lies for the greater part upon a relatively smooth plain. This indeed becomes rolling, and even to some extent rugged and mountainous at the east, but for the greater part the ancient ice sheet deployed with very great

freedom upon a plain of moderate undulation. It is therefore a matter of much good fortune to find a portion of Greenland upon which the glaciers are now deploying with something of the freedom that the Pleistocene glaciers enjoyed upon the mainland. The outward movement of the ice upon the plateau surface of the Inglefield Gulf region is scarcely less free than upon the average surface of the mainland field. It is, I think, on the whole, more free than the ancient deployment was upon the average surface of New England and the Middle states, though somewhat less free than that upon the average plains of the upper Mississippi and of the great interior of Canada. The interruptions of the movement at the border of the ice consisted almost solely of the effects of the valleys that led down to the Gulf. Into these a portion of the border of the ice sheet crept and stretched forward in tongues from one to three miles long, or in the greater valleys at the head of the bays, a few miles longer. In about half these cases the glacial tongues reached the sea level. In the remainder, they stopped short by distances ranging from a few rods to two or three miles.

The geological structure of Greenland is in general unfavorable to glacial studies. The prevalence of any single formation in a glacial region is infelicitous, because it fails to furnish data for determining the precise locality from which given bowlders have been derived, and hence for ascertaining the courses they have pursued, the rate of wear, and other vital elements of their history. It is especially unfortunate when the formation is one so versatile and deficient of order as the great crystalline complex of Greenland. There is in this case the added misfortune that the débris is chiefly coarse and arenaceous, and hence that characteristic admixture of clay and bowlders which constitutes till, the most typical glacial formation, is generally absent. Not only are the conditions of identification unfavorable, but the conditions for production are adverse.

In the Inglefield Gulf region, however, there is considerable relief from these untoward features. The clastic series contains enough of material reducible to a fine silt to give, under suitable

conditions, a typical bowlder clay, or, if not, at least a distinctive bowldery silt or bowldery sand which clearly stands in its stead. But of much more consequence is the fact that the clastic series forms only a narrow belt along the coast, and that the limits of this, in chosen cases, can be closely determined, so that the extent to which drift has been transported can be approximately learned. From this the intensity of the glacial action may be estimated by a comparison of the amount of abrasion with the distance of transport. Of more consequence than this, even, is the opportunity afforded for observing the position of material of known source in the ice, and hence of judging of the conditions under which the material is introduced into the ice, the method of its introduction, and the course it pursues in the ice. It has been the growing conviction of students of the Pleistocene drift that a large percentage of the material was derived from points not very distant from the places of final deposition. The opportunity to determine how far such local action is the habit of the Greenland glaciers is, therefore, one of the felicitous features of the Inglefield Gulf region.

*Glaciers of Northumberland Island.*—At the mouth of Inglefield Gulf lie two very considerable islands, Northumberland and Herbert. These present interesting phases of local glaciation that are worthy of a passing word, though it can only be a very general one, as they were merely observed from a distance while the vessel was detained in the vicinity by the ice. On Northumberland Island a considerable ice field accumulates, although its elevation is apparently much short of 3000 feet, and several small glaciers creep down to the vicinity of the sea level. While the plateau surface contributes measurably to the formation of the glaciers, their gathering ground seems to be chiefly in amphitheatres at the heads of valleys, which have developed notable dimensions and taken on the form of circs. Their peculiarity is a circ-like development in the margin of the plateau, combined with an inflow from the plateau surface above. The accumulation of snow is perhaps more due to the lodgment of the wind drift in the amphitheatres than to direct precipitation. In sur-

rounding regions, the heads of the valleys leading from the upper plain down toward the gulf do not usually develop notable circs. From these amphitheatres the glaciers gather into the narrower and lower portion of the valleys and creep down to the vicinity of the sea level. For the greater part they do not actually reach the sea, but stop a little short of it. It is notable that a large part of the drift they have brought down has accumulated at and under their lower extremities, so that they may be said to be creeping out upon causeways, or their feet may be

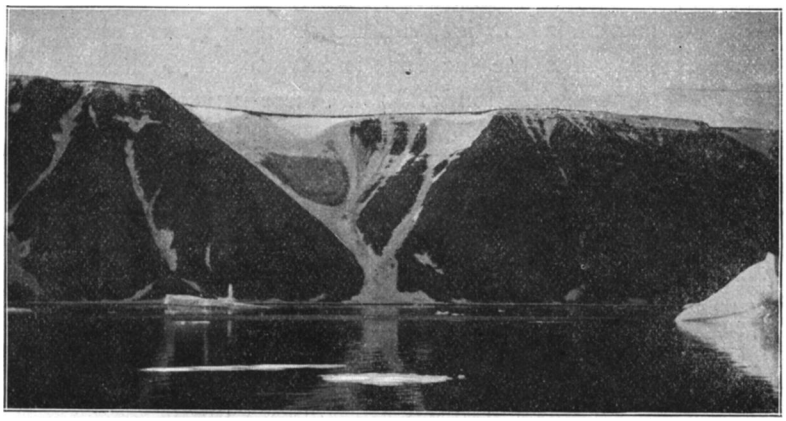


FIG. 18.—Baby Glacier, on the north side of Herbert Island.

said to rest upon pedestals of their own production. Some question might arise as to whether this was not an illusion due to the deceptive appearance of a closely hugging circumvallate moraine, if, fortunately, the glaciers had not in part retired and revealed the terrace-like nature of the pedestal, and if observations elsewhere, to be described later, had not put the verity of the phenomenon beyond question. Professor Libbey quite independently noted the same phenomenon on Herbert Island, and Lieutenant Peary had anticipated us both in remarking it at many places.

*Glaciers on Herbert Island.*—On the south side and on the west end of Herbert Island glaciers appear to be altogether absent. The valleys leading down from the summit to the water's edge

are free from snow in midsummer, and scattered vegetation makes them the haunt of the reindeer. On the north side, however, there are several diminutive glaciers that are notable for the smallness of their collecting grounds and the steepness of their descents. This is perhaps sufficiently illustrated in the accompanying figure to make description needless. (Fig. 18). This one is so small, so simple, so self-explanatory, as to almost suggest its removal to a museum for illustrative purposes. Small as it is, the fine curvation of its lines of movement is ample

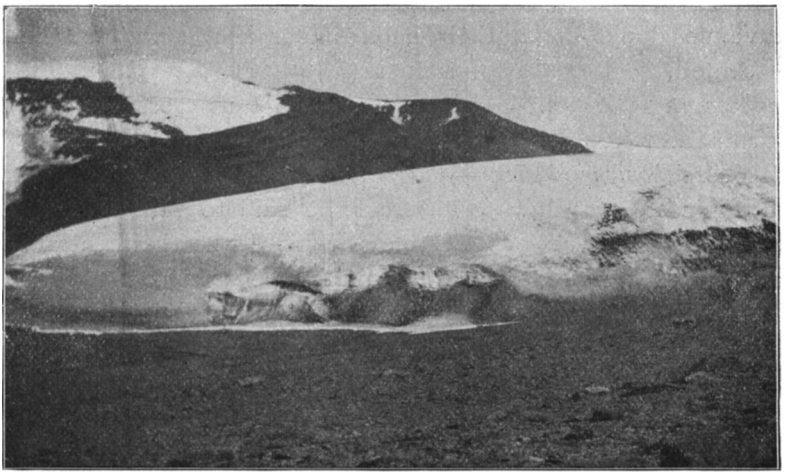


FIG. 19.—Lower portion of the Igloodahomyne Glacier, seen from the southeast.

demonstration of its true glacial nature. The photograph from which the illustration is derived was taken on one of the last days of July, and the melting of August doubtless removed essentially all of the snow that gives the white Y-like snow-figure of the illustration and left still more simplified and expressive the little lobular glacierette, the Baby glacier.

The straightness of the sky line shown in the figure is worthy of note as an indication of the smoothness of the summit plain, which is a part of that previously mentioned as a characteristic of the region. This is too smooth, however, to be quite representative. The glacier here illustrated lies near the western end

of the island. There are some farther to the east which have made a larger growth with a lower inclination. These, like the glaciers of Northumberland Island, terminate on pedestals of their own construction, and of even more characteristic development since the glaciers are narrower and smaller. Here also, fortunately, there has been, in one case in particular and in two or three others subordinately, such a retreat of the ice foot as to leave the pedestal well exposed. One might suppose that glaciers descending so precipitously would plow out their valleys even down to their extremities, but these abandoned pedestals leave no doubt as to their habit under the conditions here presented.

Leaving these little island glaciers, let us cross Murchison Sound and take up the study of a tongue of the great ice cap.

*Igloodahomyne glacier.*[1]—This glacier lies west of the mouth of Robinson Bay and can scarcely be said to fall within the strict environs of Inglefield Gulf, or even of its northern entrance, Murchison Sound. It belongs rather to the glaciers that cluster about the extreme head of Baffin's Bay. It is a tongue of the ice cap of Prudhoe Land which in turn is a broad peninsular extension of the great interior ice field. The tongue can scarcely be three miles long, and it falls nearly two miles short of reaching the coast line. It is a typical glacial tongue developed on the edge of the ice cap through the influence of the valley which it occupies. It descends from the main ice cap into the valley rather abruptly but without excessive crevassing. Lateral contributions are added in its upper portion, owing to the fact that the valley reaches back into the border of the ice

[1] It is my desire that all the names of glaciers in the environs of Inglefield Gulf which are used in this series of papers shall be credited to Lieutenant Peary. In most cases they are names definitely chosen by him and kindly placed, together with much other valuable data, at my service. In a few cases more than one name had been used or a descriptive phrase employed. It was understood that before we parted a final selection of names would be made, but the multitude of engrossing and diverting subjects that pressed upon our attenion led to its being overlooked. In consultation with Mrs. Peary and Mr. Diebitsch a few names have been chosen to complete the list in accordance with what it is presumed might have been Mr. Peary's choice. The right of nomenclature clearly rests with him.

field. It seemed also to receive small contributions from accumulations of snow on the *edge* of some of the promontories of the upper part of the valley. These were not reached, and the observation may be erroneous, but so far as could be judged by inspection with a glass at a distance of a mile or less, it would appear that large quantities of snow had been accumulated by the wind under the protection of some of the promontories, and that this gradually passed into the form of a subglacier and joined the main tongue. This appeared all the more abnormal because valleys immediately adjacent did not appear to contribute ice streams to the main tongue. There is perhaps nothing abnormal in the phenomenon, however, since it is largely a question of æolian accumulation, and the facilities for lodgment might, under given topographic conditions and special relations to predominant winds, be dependent on promontories rather than valleys.

Below the glacier the valley was found to have a broad, flat, gravelly bottom formed by wash from the glacier. Its ascent between the beach and the foot of the glacier was about 200 feet. No moraine appeared at the end of the glacier. The smooth, gravelly bottom extended uninterruptedly up to the very edge of the ice. This may as well be seen by consulting the accompanying illustrations (Figs. 19 and 21). Not only was this true, but on inspecting the terminus of the glacier no signs of activity were observable. The photographic illustrations will give the reader some suggestion of the inertness that apparently prevails. The edge of the ice may be seen to rest upon the gravelly bottom of the valley with a thin fringe of snowy residue which even in the last days of July and with the southern frontage remains as a representative of the accumulation of the preceding winter, and is still unruptured and undisturbed. On following the border of the ice around to the side of the valley the absence of obvious signs of motion became even more declared. Wash from the adjacent slope had obviously been carried out upon the edge of the ice and had partially buried it, and this had apparently suffered much melting during the preceding season or seasons as well as the current one, but no

clear signs of disturbance by any notable movement of the ice foot was detected. The characteristic humpy surface due to such melting of ice under débris is illustrated in Fig. 20. Here the débris seen in the center foreground is chipstone brought down from the slope on the right. The ice underlies it entirely across the foreground. Farther back and higher up in the left

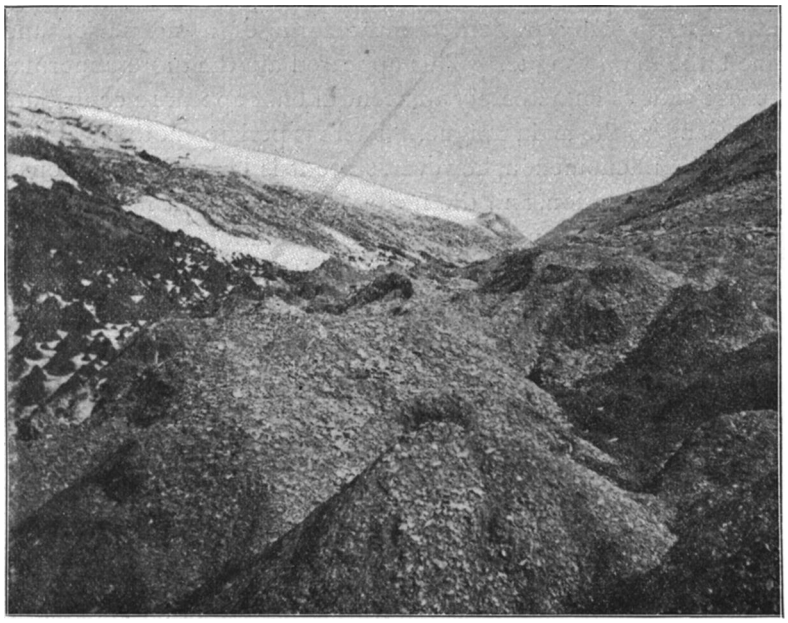


FIG. 20.—Phenomena on the southeast border of the Igloodahomyne Glacier. The débris from the bluff of sandstone and shale on the right has been washed upon the edge of the ice which has been subsequently melted in part, resulting in a characteristic humpy surface.

central portion of the figure, an inclined belt of lateral morainic material may be seen on the ice slope. Apparently here is the decadence of several seasons undisturbed by any sensible motion of the ice, a state of practical stagnation. It is obvious that the ice border has recently retreated. But this might take place with the ice still creeping on at an appreciable rate and with disturbing effects if the wastage were superior to the advance. It

would appear that though the wastage was very small, the onward movement was so much smaller as to give almost no visible signs of motion at the margin. Some motion is, of course, implied by the very existence of the glacier and its lateral moraines. The absence of appreciable disturbance of any kind is notable because it betrays the sluggishness of the glacial

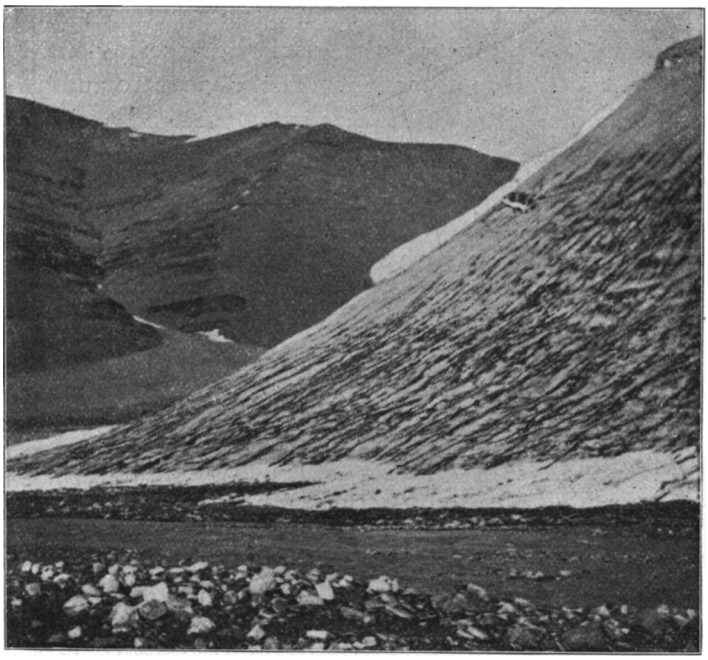


FIG. 21.—Terminal slope of the Igloodahomyne Glacier; gravel plain and glacial stream in the foreground; alluvial cone and bluffs of sandstone and shale in the background.

activity. So slight was the evidence of motion at the front of the glacier that I was prompted to resort to the closest available method of measurement to determine it—by fixing a stone in the edge of the ice and accurately measuring with a steel tape line the distance from it to a fixed object in front of the glacier—but unfortunately no opportunity to return and make a second measurement was afforded.

The terminal slope of the glacier was steep but not vertical. In some portions it curved rapidly downward to the base, but for the larger part it dropped away somewhat suddenly from a point well up on the brow, the descent being a nearly plane slope, at some points even slightly concave. Along a portion of the face there had been some undermelting, giving an approach to verticality (see Fig. 19). These terminal features place the Igloodahomyne glacier in a class between the Disco glaciers and the majority of the glaciers of the Inglefield Gulf region presently to be described. The Figures 19 and 21 illustrate some of the forms of the terminal slope.

The transverse profile of the glacier, as seen from the valley below, is a quite flat curve, as may be inferred from Fig. 19, the point of view of which is oblique and too near, or still better from Fig. 5 in the introductory narrative, the point of view of which is more distant and more nearly central, although still east of the center of the valley. There is, as will be observed, little débris on the surface of the glacier except near the side.

Ascending to the back of the glacier, which was accomplished without difficulty from the side, there was found to be considerable débris in the lower part of the ice at its lateral edge, but this disappeared as the upper surface was reached. Farther up the valley, on the east side, a very considerable lateral moraine was observed.

The ice was found to be solid and almost free from crevasses on the eastern side, though here and there fissures gaping a few inches were crossed. On the western side crevasses of a few feet in breadth were somewhat frequent over a tract adjacent to a convex border, to the stretching of which they may doubtless be attributed. These crevasses were old and snow-filled for the greater part. Only here and there were there indications of freshly opened fissures, and these were to be measured rather by inches than by feet.

Although it was then a month past the summer solstice, the surface of the glacier was still partially covered with the snows of the preceding winter and spring. Remnants occurred at

almost all elevations, and from a height of 1500 feet upward snow spread over the larger portion of the surface of the glacier; large depressions had indeed been made in it by the heat of the sun, and here and there it was completely removed. Occasional snows fell during the latter part of August and permanent snow was to be expected in September. The amount of surface wastage which the season permitted could not, therefore, be very great, and the inactivity of the glacial mass, as shown by its

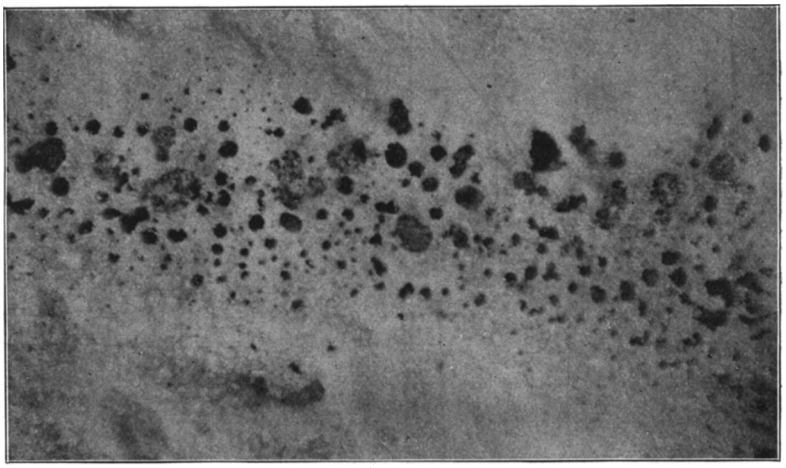


FIG. 22.—Dust wells on the Igloodahomyne Glacier; taken with the camera held directly above them. The largest are about two inches in diameter.

border, is in signal harmony with this limited wastage, which is the factor over against which its motion balanced in determining the status of the mass. It would appear that the wastage is as notably slight as the motion. It is doubtless unsafe, however, to urge these considerations very far, because the season was probably unusually adverse.

At the time of our visit the melting of the surface was markedly rapid, and swift little rills streamed down the slopes of the glacier in miniature channels cut in its surface. The relative absence of crevassing permitted these to run long courses, and by joining each other to form considerable streamlets near the

ends or sides of the glacier from which they plunged downwards in beautiful little cascades.

Perhaps the most interesting feature of the surface of the glacier was its numerous dust wells, a phenomenon which Nordenskjöld brought pointedly to public attention some years since. Upon this glacier they were relatively small but exceedingly numerous and widely distributed. They are cylindrical tubes penetrating the ice to a depth of six or eight inches, or occasionally a little more. They ranged in size from tubelets which would scarcely more than admit a lead pencil up to wells of a foot or more in diameter, though the latter sizes were rather rare. Occasionally they were double or complex, due perhaps in part to the joining of two or more smaller tubes, and in part to original irregularity in the distribution of the dust which formed them. Sometimes there was a central column of ice reaching from the bottom to a capping above which implies the former explanation. The tubes were singularly vertical. Nowhere were they observed to incline to the northward, as holes melted in the snow in southern latitudes so commonly do. There was, however, no question as to their being the effects of melting. At the bottom of each was a thin film of black dust which was their obvious cause. This dust, catching the sunlight and transforming its energy, melted its way downward. The circular course of the sun doubtless tended to correct any tendency to inclination, but even in this latitude the difference between the heat of the southerly and the northerly sun is quite pronounced, and the verticality is apparently independent of the inclination of the sun's rays.

It was noticed that a film of ice frequently stretched across the upper part of these wells, and that the water within them had shrunk away two or three inches from the film. Occasionally there was a second film of two or three inches below the first, and the water had sometimes shrunk away from this also. Obviously the well had been nearly full when the first film of ice was formed, for the most of them were near the mouth of the well. As these observations were made near midday, the sug-

gestion that sprang from the phenomenon was that the film of ice had frozen during the preceding night, and that the falling away of the water beneath represented the amount of absorption of the glacier in the interval, say ten or twelve hours. The significance of this as indicating the facility with which a glacier drinks up water on the surface became obvious, and the desirability of making direct observations upon the wells to determine this was fully appreciated, but the demands of other lines of work and the distance from headquarters of wells suitable for the observations, rendered this impracticable. In another way, however, the suggestions of the phenomenon were in a measure verified. It was observed that whenever thawing was checked by cold weather, it was quite promptly followed by the entire disappearance of the water from the wells. On my first visit to the main ice cap, northeast of Bowdoin Bay, August 7, the surface was saturated with water and the wells were full. On my second visit, on August 10, water was observed only in the ravines into which it had gathered from considerable areas. The surface was then covered with six inches of fresh snow, and special search was not made to determine the presence or absence of water in the wells and the observation was unsatisfactory. On my third visit, August 18, very diligent search was made and no water whatever found in even the largest and deepest of the wells, and these were here of considerable dimensions. It therefore appeared quite certain that the water that was melted upon the surface was absorbed with considerable rapidity into the glacier. Doubtless this descends into its depths. The percentage of the product of melting that is thus absorbed and the rapidity with which it descends into the greater depths are certainly matters of much interest and obviously invite investigation.

The dust in the wells is quite certainly of terrestrial origin, in the main, at least. In some instances fragments of shale were discernible with the naked eye.

The drainage of the Igloodahomyne glacier presents a departure from the method prevalent in Alpine glaciers, though it is

the common habit of this region. The familiar central tunnel, or main drainage line near the middle of the valley was absent, and only little streamlets flowed away from this portion of the glacier. These were very largely formed from the streamlets of the surface which came cascading down the terminal face. No large amount of water appeared to be coming from beneath the base, and this was not murky from glacial silt, as is the manner of streams issuing from beneath active glaciers. The main drainage from the glacier flowed along its two sides. At its extremity these lateral streams followed down the borders of the frontal plain, or turned obliquely out toward the center, branching meanwhile freely, and at length usually came together some distance below the end of the glacier. These lateral streams were murky with silt, but whether it was chiefly due to their tumultuous descent over the lateral débris, or to subglacial grindings, it was not easy to determine. There was doubtless something of both.

The valley occupied in part by the Igloodahomyne glacier afforded an interesting opportunity for comparing the relative rates of meteoric degradation and glacial erosion, though beyond a doubt the comparison is very unfair to the glacier, for here its power was at an extreme minimum, while the steep faces of the adjacent bluffs and the very effective frost action intensified the meteoric agencies of degradation to nearly their maximum efficiency. It was none the less interesting to observe that on the sides of the valley very large and symmetrical alluvial cones were formed at the foot of ravines leading up to the summit plateau. The valley below the glacier retained very little sign of previous glacial occupancy. (See background of Fig. 21.) Attention has already been called to the spreading of one of these alluvial cones out upon the edge of the glacier. A comparison between the facility with which these alluvial cones were formed, and the rate of glacial corrasion, was here at least altogether unfavorable to the latter. But, as remarked before, this is taking the glacier at the greatest disadvantage.

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